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Comparative Charts of the Region following δ Ophiuchi.

By Percival Lowell.

In an examination of the region following δ *Ophiuchi* Mr. Lampland found that the faintest stars visible through the 36-inch glass of the Lick Observatory as recorded in Tucker's map of the region, and consisting of seventeenth-magnitude stars, were perfectly visible at Flagstaff with the 24-inch glass of this observatory. To test the point thoroughly charts of the region were accordingly made by him and by the writer independently. Rainy weather (thunderstorms) and moonlight somewhat interfered with both observers, especially with Mr. Lampland, who had the least good hours. The charts of the two substantially agreed, and the writer's is here given. Together with it charts of the same region have, by permission, been reproduced: the one, by Dr. Holden, I believe, made with the 26-inch glass of the Naval Observatory at Washington about twenty years ago; the other, the one mentioned above, by Mr. R. W. Tucker at the Lick Observatory in 1894.

The stars shown in the three maps are respectively :—

United States Naval Observatory	...	63 stars
Lick Observatory	... ...	161 ,,
Lowell ,,	... ...	172 ,,

Their separation into magnitudes will be found under the several charts.

The writer's chart was made independently of Mr. Tucker's—except that the latter's positions for the brighter stars was followed, which was the course Tucker himself had pursued with the Washington one—and then was afterwards compared with his. It does not pretend to be exhaustive, as it was made in the bad season, but will suffice for purposes of comparison.

As the difference in light between consecutive magnitudes is 2·5 times the lesser, and the light-gathering power of 36 inches is 2·25 times that of 24 inches, the difference in aperture should, other things being equal, have meant nearly a magnitude lower for the stars shown by the larger glass. As the Flagstaff glass actually revealed more stars than the Lick, these charts would indicate that the difference in the clarity and definition of the air of the two sites amounted to about one magnitude. In this connection it is interesting to note the respective altitudes of the several stations :—

Washington	... ...	50	feet above sea-level.
Mount Hamilton ...	...	4200	,, ,,
Flagstaff ...	... ...	7250	,, ,,

Though undoubtedly a factor, height was probably aided by steadiness; since the steadier a star, within certain limits, the more impression it would make on the retina.

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On the Conditions determining the Formation of Cloud-spheres and Photospheres. By Arthur W. Clayden, M.A.

In the course of an investigation of the conditions under which clouds may be formed in our own atmosphere certain considerations presented themselves which seem equally applicable to the conditions which determine the position of a stellar photosphere in the mass of a star.

As the spectrum of a star is to a great extent dependent upon the position of the photosphere it seems possible that a survey of these points may help to clear up some of the difficulties attending the interpretation of spectral details.

To begin with it is necessary to ask that it may be taken for granted—

1. That the photosphere of a star is the upper surface of a stratum of clouds.
2. That those clouds are caused by the condensation of some substance from the state of vapour to that of small solid or liquid particles.
3. That the condensation is due to cooling produced by expansion brought about by the ascent of vapour-charged convection currents.
4. That the cooling effect of expansion follows the same general thermodynamic law as is the case in our own atmosphere.

It is true that under the high pressures and temperatures of a star the gradation of temperature may be considerably modified. The transference of heat from one stratum to a higher by conduction and radiation should tend to equalise temperatures, but the increased viscosity due to pressure should tend in the opposite direction. Hence a curve showing the relations of temperature and pressure is not likely to differ very greatly from one plotted in accordance with the expression

$$\frac{\log t - \log t'}{\log p - \log p'} = \frac{\gamma - 1}{\gamma}$$

in which t is the absolute temperature at a pressure p, and t' is the absolute temperature at the reduced pressure p' ; γ is, of course, the ratio of the two specific heats.

In order to argue from the known to the unknown, let us first consider the case of planetary bodies surrounded by an atmosphere consisting wholly of water, a substance whose temperature-pressure relations are well understood.

At temperatures far below freezing-point ice gives off vapour which exerts a certain maximum pressure. As the temperature rises this maximum pressure increases more and more rapidly. This goes on until 365° C. is reached, at which point the maximum pressure is 200·5 atmospheres. If at any temperature the pressure be less than the maximum, evaporation will take place ;

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